3.2 AGING MANAGEMENT OF ENGINEERED SAFETY FEATURES

Review Responsibilities

Primary - Branches assigned responsibility per SRP-LR section 3.0

3.2.1 Areas of Review

This review plan section addresses the aging management review (AMR) of the engineered safety features. For a recent vintage plant, the information related to the engineered safety features is contained in Chapter 6, "Engineered Safety Features," of the plant's FSAR, consistent with the "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (NUREG-0800) (Ref. 1). The engineered safety features contained in this review plan section are generally consistent with those contained in NUREG-0800 except for the refueling water, control room habitability, and residual heat removal systems. For older plants, the location of applicable information is plant-specific because their FSAR may have predated NUREG-0800. The engineered safety features consist of containment spray, standby gas treatment (BWRs), containment isolation components, and emergency core cooling systems.

The responsible review organization is to review the following LRA AMR and AMP items, assigned to it, per SRP-LR section 3.0, for review:

AMRs

- AMRs consistent with the GALL report, for which further evaluation is not recommended
- AMRs consistent with the GALL report, for which further evaluation is recommended
- AMRs not consistent with the GALL report

AMPs

- AMPs consistent with GALL AMPs
- Plant-specific AMPs

FSAR Supplement

- In addition, the responsible review organization is to review the FSAR supplement associated with each assigned AMP.

3.2.2 Acceptance Criteria

The acceptance criteria for the areas of review describe methods for determining whether the applicant has met the requirements of the NRC's regulations in 10 CFR 54.21.

3.2.2.1 AMR Results Consistent with the GALL Report for Which No Further Evaluation is Recommended

The aging management review and acceptable aging management programs applicable to the engineered safety features are described and evaluated in Chapter V of the GALL report (Ref. 2).

The applicant's LRA should provide sufficient information so that the NRC reviewer is able to confirm that the specific AMR line-item and the associated AMP are consistent with the cited GALL AMR line-item. The staff reviewer should then confirm that the LRA AMR line-item is consistent with the GALL line-item to which it is compared.

If the applicant identifies an exception to the cited GALL AMP, the LRA should include a basis or reference how the criteria of 10 CFR 54.21(a)(3) would still be met. The NRC reviewer should then confirm that the AMP with all exceptions would satisfy the criteria of 10 CFR 54.21(a)(3). If, while reviewing the AMP, the reviewer identifies a difference from the GALL AMP, this difference should be reviewed and dispositioned as if it was an exception identified by the applicant in its LRA. The disposition of all LRA-defined exceptions and staff-identified differences should be documented.

The LRA should identify any enhancements that are needed to permit an existing aging management program to be declared consistent with the GALL AMP to which the LRA AMP is compared. The reviewer is to confirm both that the enhancement, if implemented, would allow the existing plant aging management program to be consistent with the GALL AMP and also that the applicant has a commitment to implement the enhancement prior to the period of extended operation. The reviewer should document the disposition of all enhancements.

3.2.2.2 AMR Results Consistent with the GALL Report for Which Further Evaluation is Recommended

The basic acceptance criteria defined in 3.2.2.1 apply to all of the AMRs and AMPs reviewed as part of this section. In addition, if the GALL AMR line-item to which the LRA AMR line-item is compared identifies that "further evaluation is recommended," then additional criteria apply as identified by the GALL report for each of the following aging effect/aging mechanism combinations.

3.2.2.2.1 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.3 of this standard review plan.

3.2.2.2.2 Loss of Material due to General Corrosion

Loss of material due to general corrosion could occur for the internal and external surfaces of BWR and PWR steel components exposed to air and moisture. The GALL report recommends further evaluation on a plant specific basis to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this standard review plan).

3.2.2.2.3 Loss of Material due to Pitting and Crevice Corrosion

1. Loss of material due to pitting and crevice corrosion could occur for stainless steel piping, piping components, and piping elements exposed to treated water and the GALL report recommends that a plant-specific aging management program should be evaluated. The existing aging management program relies on monitoring and control of water chemistry based on EPRI guidelines of TR-105714 for PWRs (Ref. 3) and BWRVIP 29 (EPRI TR-103515) for BWRs (Ref. 4) to mitigate degradation. However, control of water chemistry

does not preclude loss of material due to crevice and pitting corrosion at locations of stagnant flow conditions. Therefore, verification of the effectiveness of the chemistry control program should be performed to ensure that corrosion is not occurring. The GALL report recommends further evaluation of programs to manage the loss of material due to pitting and crevice corrosion to verify the effectiveness of the chemistry control program. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly so that the component's intended function will be maintained during the period of extended operation.

2. Loss of material from pitting and crevice corrosion could occur for stainless steel components in contact with untreated or raw water. The GALL report recommends that a plant-specific aging management program be evaluated for the bottom of partially encased tanks because moisture and water can egress under the tank due to cracking of the perimeter seal from weathering. The GALL report recommends further evaluation to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RSLB-1 (Appendix A.1 of this standard review plan).

3.2.2.2.4 Loss of Material due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion

Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion (MIC) could occur for steel BWR and PWR containment isolation piping, piping components, and piping elements in systems that are not addressed in other chapters of the GALL report. The GALL report recommends further evaluation to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RSLB-1 (Appendix A.1 of this standard review plan).

3.2.2.2.5 Hardening and Loss of Strength due to Elastomer Degradation

Hardening and loss of strength due to elastomer degradation could occur in seals associated with BWR standby gas treatment system ductwork and filters. The GALL report recommends further evaluation to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RSLB-1 (Appendix A.1 of this standard review plan).

3.2.2.2.6 Loss of Material due to Erosion

Loss of material due to erosion could occur in the high pressure safety injection pump miniflow recirculation orifice. This aging mechanism and effect will apply only to pumps that are normally used as charging pumps in the chemical and volume control systems (PWRs). The GALL report recommends a plant-specific aging management program be evaluated for erosion of the orifice due to extended use of the centrifugal HPSI pump for normal charging. See LER 50-275/94-023 for evidence of erosion. Further evaluation is recommended to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RSLB-1 (Appendix A.1 of this standard review plan).

3.2.2.2.7 Macrofouling and Loss of Material

1. Macrofouling and loss of material due to general, pitting, crevice and microbiologically influenced corrosion could occur for the internal surfaces of steel and stainless steel containment isolation piping, piping components, and piping elements in contact with raw

water. The GALL report recommends further evaluation to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RSLB-1 (Appendix A.1 of this standard review plan).

2. Macrofouling from loss of material due to general corrosion could occur for the BWR steel drywell and suppression chamber spray system. This could result in plugging of the spray nozzles and flow orifices. This aging mechanism and effect will apply since the spray nozzles and flow orifices are occasionally wetted, even though the majority of the time this system is on standby. The wetting and drying of these components can accelerate corrosion. The GALL report recommends further evaluation to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RSLB-1 (Appendix A.1 of this standard review plan).

3.2.2.2.8 Loss of material due to General, Pitting and Crevice Corrosion

1. Loss of material due to General, pitting and crevice corrosion could occur for BWR steel piping, piping components, and piping elements in contact with treated water. The existing aging management program relies on monitoring and control of water chemistry based on EPRI guidelines of BWRVIP 29 (EPRI TR-103515) for BWRs (Ref. 4) to mitigate degradation. However, control of water chemistry does not preclude loss of material due to general, pitting, and crevice corrosion at locations of stagnant flow conditions. Therefore, verification of the effectiveness of the chemistry control program should be performed to ensure that corrosion is not occurring. The GALL report recommends further evaluation of programs to verify the effectiveness of the chemistry control program. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

2. Loss of material due to general, pitting and crevice corrosion could occur for steel ducting closure bolting in uncontrolled air and for the internal surfaces of piping, piping components, and piping elements in contact with treated water or subject to wetting by condensation. The GALL report recommends further evaluation to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RSLB-1 (Appendix A.1 of this standard review plan).

3. Loss of material due to general, pitting and crevice corrosion could occur for steel piping, piping components, and piping elements buried in soil. The buried piping and tanks inspection program relies on industry practice, frequency of pipe excavation, and operating experience to manage the effects of loss of material from general, pitting, and crevice corrosion and MIC. The staff reviews the applicant's program, including inspection frequency and operating experience with buried components, to assess the effectiveness of the buried piping and tanks inspection program in ensuring that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation..

3.2.2.2.9 Quality Assurance for Aging Management of Nonsafety-Related Components

Acceptance criteria are described in Branch Technical Position IQMB-1 (Appendix A.2 of this standard review plan.)

3.2.2.3 AMR Results Not Consistent with or Not Addressed in GALL Report

Acceptance criteria are described in Branch Technical Position RSLB-1 (Appendix A.1 of this standard review plan).

3.2.2.4 FSAR Supplement

The summary description of the programs and activities for managing the effects of aging for the period of extended operation in the FSAR supplement should be appropriate such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the bases for determining that aging effects will be managed during the period of extended operation. The description should also contain any future aging management activities, including enhancements, to be completed before the period of extended operation. Examples of the type of information required are provided in Table 3.2-2 of this standard review plan.

3.2.3 Review Procedures

For each area of review, the following review procedures are to be followed.

3.2.3.1 AMR Results Consistent with the GALL Report for Which No Further Evaluation is Recommended

The applicant may reference the GALL report in its license renewal application, as appropriate, to demonstrate that the aging management reviews and programs at its facility are consistent with those reviewed and approved in the GALL report. The reviewer should not conduct a re-review of the substance of the matters described in the GALL report. If the applicant has provided the information necessary to adopt the finding of program acceptability as described and evaluated in the GALL report, the staff should find acceptable the applicant's reference to GALL in its license renewal application. In making this determination, the reviewer confirms that the applicant has provided a brief description of the system, components, materials, and environment. The reviewer also confirms that the applicant has stated that the applicable aging effects and industry and plant-specific operating experience have been reviewed by the applicant and are evaluated in the GALL Report.

Furthermore, the reviewer should confirm that the applicant has addressed operating experience identified after the issuance of the GALL report. Performance of this review requires the reviewer to confirm that the applicant has identified those aging effects for the engineered safety features system components that are contained in GALL as applicable to its plant.

The reviewer confirms that the applicant has identified the appropriate AMPs as described and evaluated in the GALL report. If the applicant commits to an enhancement to make its aging management program consistent with a GALL AMP, then the reviewer is to confirm that this enhancement when implemented will indeed make the LRA AMP consistent with the GALL AMP. If an aging management program in the LRA identifies an exception to the GALL AMP to which it is claiming to be consistent, the reviewer is to confirm that the LRA AMP with the exception will satisfy the criteria of 10CFR54.21(a)(3). If the reviewer identifies a difference, not identified by the LRA, between the LRA AMP and the GALL AMP, to which the LRA claims to be consistent, the reviewer should confirm that the LRA AMP with this difference satisfies 10CFR54.21(a)(3). The reviewer should document the basis for accepting enhancements, exceptions or differences. The AMPs evaluated in GALL pertinent to the engineered safety features components are summarized in Table 3.2-1 of this standard review plan.

3.2.3.2 AMR Results Consistent with the GALL Report for Which Further Evaluation is Recommended

The basic review procedures defined in 3.2.3.1 apply to all of the AMRs and AMPs provided in this section. In addition, if the GALL AMR line-item to which the LRA AMR line-item is compared identifies that "further evaluation is recommended," then additional criteria apply as identified by the GALL report for each of the following aging effect/aging mechanism combinations.

3.2.3.2.1 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The staff reviews the evaluation of this TLAA separately, following the guidance in Section 4.3 of this standard review plan.

3.2.3.2.2 Loss of Material due to General Corrosion

1. The GALL report recommends further evaluation of programs to manage the loss of material due to general corrosion of steel piping, piping components, and piping elements associated with some of the BWR emergency core cooling systems [high pressure coolant injection, reactor core isolation cooling, high pressure core spray, low pressure core spray, low pressure coolant injection (residual heat removal)] and with lines to the suppression chamber and to the drywell and suppression chamber spray system to verify the effectiveness of the chemistry control program. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

   The reviewer reviews the applicant's proposed program to determine whether corrosion is not occurring or the corrosion is progressing very slowly so that the component's intended function will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The inspection techniques may include visual, ultrasonic, and surface examination techniques. Follow-up actions are to be based on the inspection results.

2. The GALL report recommends further evaluation of programs to manage the loss of material due to general corrosion of the internal and external surfaces of BWR and PWR steel components exposed to air and moisture . The reviewer reviews the applicant's proposed programs on a case-by-case basis to ensure that an adequate program will be in place for the management of general corrosion of these components.

3.2.3.2.3 Loss of Material due to Pitting and Crevice Corrosion

1. The GALL report recommends further evaluation of programs to manage the loss of material due to pitting and crevice corrosion of stainless steel piping, piping components, and piping elements exposed to treated water to verify the effectiveness of the chemistry control program. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect

is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

The reviewer reviews the applicant's proposed program to determine whether corrosion is not occurring or the corrosion is progressing very slowly so that the component's intended function will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The inspection techniques may include visual, ultrasonic, and surface examination techniques. Follow-up actions are to be based on the inspection results.

2. The GALL report recommends further evaluation of programs to manage the loss of material due to pitting and crevice corrosion of the bottom of partially encased stainless steel General, pitting, crevice, and tanks because moisture and water can egress under the tank due to cracking of the perimeter seal from weathering The reviewer reviews the applicant's proposed programs on a case-by-case basis to ensure that an adequate program will be in place for the management of Loss of material due to pitting and crevice corrosion of these components.

3.2.3.2.4 Loss of Material due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion

The GALL report recommends further evaluation of programs to manage the Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion of the BWR and PWR containment isolation piping, piping components, and piping elements that are not addressed in other chapters of the GALL report. The reviewer reviews the applicant's proposed programs on a case-by-case basis to ensure that an adequate program will be in place for the management of this aging for the BWR and PWR containment isolation barriers.

3.2.3.2.5 Hardening and Loss of Strength due to Elastomer Degradation

The GALL report recommends further evaluation of programs to manage changes in properties due to degradation of elastomer seals associated with BWR standby gas treatment system ductwork and filters. The reviewer reviews the applicant's proposed programs on a case-by-case basis to ensure that an adequate program will be in place to manage changes in properties due to degradation of elastomer seals in the standby gas treatment system.

3.2.3.2.6 Loss of Material due to Erosion

The GALL report recommends further evaluation of programs to manage Loss of material due to erosion of the high pressure safety injection pump miniflow orifice. The reviewer reviews the applicant's proposed programs on a case-by-case basis to ensure that an adequate program will be in place to manage this aging effect.

3.2.3.2.7 Macrofouling from Loss of Material due to General Corrosion

1. The GALL report recommend further evaluation to manage macrofouling and loss of material due to general, pitting, crevice and microbiologically influenced corrosion could occur for the internal surfaces of steel and stainless steel containment isolation piping, piping components, and piping elements in contact with raw water. The reviewer reviews

the applicant's proposed programs on a case-by-case basis to ensure that an adequate program will be in place to manage this aging effect.

2. The GALL report recommends further evaluation of programs to manage the plugging of spray nozzles and spargers of the BWR drywell and suppression chamber spray system. The reviewer reviews the applicant's proposed programs on a case-by-case basis to ensure that an adequate program will be in place to manage this aging effect.

3.2.3.2.8 Loss of Material due to General, Pitting and Crevice Corrosion

1. The GALL report recommends further evaluation of programs to manage loss of material due to general, pitting and crevice corrosion for BWR steel piping, piping components, and piping elements in contact with treated water to verify the effectiveness of the chemistry control program. A one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

   The reviewer reviews the applicant's proposed program to determine whether corrosion is not occurring or the corrosion is progressing very slowly so that the component's intended function will be maintained during the period of extended operation. If an applicant proposes a one-time inspection of select components at susceptible locations to ensure that corrosion is not occurring, the reviewer verifies that the applicant's selection of susceptible locations is based on severity of conditions, time of service, and lowest design margin. The inspection techniques may include visual, ultrasonic, and surface examination techniques. Follow-up actions are to be based on the inspection results

2. The GALL report recommends further evaluation of programs to manage loss of material due to general, pitting and crevice corrosion for steel ducting closure bolting in uncontrolled air and for the internal surfaces of piping, piping components, and piping elements in contact with treated water or subject to wetting by condensation. The reviewer reviews the applicant's proposed programs on a case-by-case basis to ensure that an adequate program will be in place for the management of loss of material due to general, pitting, and crevice corrosion of these components.

3. The GALL report recommends further evaluation of programs to manage loss of material due to general, pitting, and crevice corrosion of the external surfaces of underground piping, piping components, and piping elements to verify the effectiveness of the buried piping and tanks inspection program. The buried piping and tanks inspection program relies on industry practice, frequency of pipe excavation, and operating experience to manage the effects of loss of material from general, pitting, and crevice corrosion and MIC. The effectiveness of the buried piping and tanks inspection program should be verified to evaluate an applicant's inspection frequency and operating experience with buried components, ensuring that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

3.2.3.2.9 Quality Assurance for Aging Management of Nonsafety-Related Components

The applicant's aging management programs for license renewal should contain the elements of corrective actions, the confirmation process, and administrative controls. Safety-related

components are covered by 10 CFR Part 50 Appendix B, which is adequate to address these program elements. However, Appendix B does not apply to nonsafety-related components that are subject to an AMR for license renewal. Nevertheless, the applicant has the option to expand the scope of its 10 CFR Part 50 Appendix B program to include these components and address the associated program elements. If the applicant chooses this option, the reviewer verifies that the applicant has documented such a commitment in the FSAR supplement. If the applicant chooses alternative means, the branch responsible for quality assurance should be requested to review the applicant's proposal on a case-by-case basis.

3.2.3.3 AMR Results Not Consistent with or Not Addressed in GALL Report

The reviewer should confirm that the applicant, in the license renewal application, has identified applicable aging effects, listed the appropriate combination of materials and environments, and aging management programs that will adequately manage the aging effects. The aging management program credited could be an AMP that is described and evaluated in the GALL report or a plant-specific program. Review procedures are described in Branch Technical Position RSLB-1 (Appendix A.1 of this standard review plan).

3.2.3.4 FSAR Supplement

The reviewer confirms that the applicant has provided information, equivalent to that in Table 3.2-2, in the FSAR supplement for aging management of the engineered safety features for license renewal. The reviewer also confirms that the applicant has provided information, equivalent to that in Table 3.2-2, in the FSAR supplement for Subsection 3.2.3.3, "Aging Management Evaluations that Are Different from or Not Addressed in the GALL Report."

The staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR supplement at the next update required pursuant to 10 CFR 50.71(e)(4). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59.

As noted in Table 3.2-2, an applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should confirm that the applicant has identified and committed in the license renewal application to any future aging management activities to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

3.2.4 Evaluation Findings

The reviewer verifies that the applicant has provided information sufficient to satisfy the provisions of this review plan section, and the staff's evaluation supports conclusions of the following type, to be included in the staff's safety evaluation report:

> On the basis of its review, the staff concludes that the applicant has adequately identified the aging effects and the AMPs credited with managing these aging effects for the engineered safety features systems, such that there is reasonable

assurance that the component intended functions will be maintained consistent with the CLB during the period of extended operation. The staff also reviewed the applicable FSAR supplement program descriptions and concludes that the FSAR supplement provides an adequate program description of the AMPs credited for managing aging effects, as required by 10 CFR 54.21(d).

3.2.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the NRC's regulations, the method described herein will be used by the staff in its evaluation of conformance with NRC regulations.

3.2.6 References

1. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, July 1981.

2. NUREG-1801, "Generic Aging Lessons Learned (GALL)," U.S. Nuclear Regulatory Commission, July 2001.

3. EPRI TR-105714, PWR primary Water Chemistry Guidelines-Revision 3, Electric Power Research Institute, Palo Alto, CA, Nov. 1995.

4. EPRI TR-103515, BWR Water Chemistry Guidelines-Revision 1, Normal and Hydrogen Water Chemistry, Electric Power Research Institute, Palo Alto, CA, February 1994.

[Original Table Replaced In Its Entirety Below.]

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL Report

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	SRP Ref	Item Number in GALL
BWR/ PWR	Piping, piping components, and piping elements in emergency core cooling system	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA (see Subsection 3.2.2.2.1)	3.2.2.2.1	E-10 E-13 E-16
BWR/ PWR	Ducting, piping, piping components, and piping elements internal and external surfaces	Loss of material due to General corrosion	Plant specific	Yes, plant specific (see Subsection 3.2.2.2.2)	3.2.2.2.2	E-25 E-26 E-29 E-30 E-35
BWR/ PWR	Piping, piping components, and piping elements internal surfaces	Loss of material due to Pitting and crevice corrosion	Plant specific	Yes, plant specific (See subsection 3.2.2.2.3.1)	3.2.2.2.3.1	E-33
				Yes, plant specific (See subsection 3.2.2.2.3.2)	3.2.2.2.3.2	E-14
BWR/ PWR	Partially encased tanks with breached moisture barrier	Loss of material due to Pitting and crevice corrosion	Plant specific	Yes, plant specific (See subsection 3.2.2.2.3.2)	3.2.2.2.3.2	E-01
BWR/ PWR	Containment isolation piping and components external surfaces	Loss of material due to General, pitting, crevice, and MIC	Plant specific	Yes, plant specific (see Subsection 3.2.2.2.4)	3.2.2.2.4	E-32
BWR	Seals in standby gas treatment system	Hardening and loss of strength due to Elastomer degradation	Plant specific	Yes, plant specific (see Subsection 3.2.2.2.5)	3.2.2.2.5	E-05 E-06
PWR	High-pressure safety injection (charging) pump miniflow	Loss of material due to Erosion	Plant specific	Yes, plant specific (See subsection 3.2.2.2.6)	3.2.2.2.6	E-24

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL Report

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	SRP Ref	Item Number in GALL
	orifice					
BWR/ PWR	Containment isolation piping, piping components, and piping elements internal surfaces	Macrofouling and loss of material due to General, pitting, crevice and MIC	Plant specific	Yes, plant specific (See subsection 3.2.2.2.7.1)	3.2.2.2.7.1	E-22 E-34 E-36
BWR	Drywell and suppression chamber spray system nozzles and flow orifices	Macrofouling from loss of material due to General corrosion	Plant specific	Yes, plant specific (See subsection 3.2.2.2.7.2)	3.2.2.2.7.22	E-04
BWR	Piping, piping components, and piping elements in emergency core cooling system	Loss of material due to General, pitting and crevice corrosion	Water chemistry and one-time inspection	Yes, detection of aging effects is to be evaluated. See subsection 3.2.2.2.8.1	3.2.2.2.8.1	E-08
BWR/ PWR	Piping, piping components, and piping elements (internal surfaces) and ducting closure bolting	Loss of material due to General, pitting and crevice corrosion	Plant specific	Yes, detection of aging effects is to be evaluated. (See subsection 3.2.2.2.8.2)	3.2.2.2.8.2	E-27 E-31 E-40
BWR/ PWR	Buried Piping, piping components, and piping elements	Loss of material due to general, pitting, and crevice corrosion	Buried piping and tanks surveillance or Buried piping and tanks inspection	No Yes, plant specific(see subsection 3.2.2.2.8.3)	 3.2.2.2.8.3	E-42
BWR/ PWR	Piping, piping components, and piping	Loss of material due to Pitting,	Closed-cycle cooling water system	No	(blank)	EP-13

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL Report

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	SRP Ref	Item Number in GALL
	elements	crevice corrosion, and galvanic corrosion				
BWR	Piping, piping components, and piping elements	Loss of material due to Flow-accelerated corrosion	Flow-accelerated corrosion	No	NA	E-07 E-09
	Piping, piping components, and piping elements with 4 inch and larger nominal diameter	Cracking due to Stress corrosion cracking	BWR stress corrosion cracking and Water Chemistry	No	NA	E-15
BWR/ PWR	Bolting and Closure bolting	Loss of material due to General, pitting and crevice corrosion; Loss of preload due to stress relaxation; Cracking due to stress corrosion cracking and cyclic loading	Bolting Integrity	No	NA	E-02 E-03 EP-1 EP-24 EP-25
	Components serviced by closed-cycle cooling system	Macrofouling and loss of material due to General, pitting and crevice corrosion	Closed-cycle cooling water system	No	NA	E-17 E-19
	Components serviced by open-cycle cooling system	Loss of material due to General, pitting, crevice, MIC; macrofouling due to Biofouling; reduction of heat transfer	Open-cycle cooling water system	No	NA	E-18 E-20 E-21 E-23

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL Report

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	SRP Ref	Item Number in GALL
		due to biofouling				
	Gray Cast Iron Heat exchanger shell	Loss of material due to selective leaching	Selective leaching of materials	No	NA	E-43
	Piping, piping components, and piping elements	Cracking due to Stress corrosion cracking, intergranular stress corrosion cracking	Water Chemistry	No	NA	E-37
	Piping, piping components, and piping elements of CASS in emergency core cooling systems	Loss of fracture toughness due to Thermal aging embrittlement	Thermal aging embrittlement of CASS	No	NA	E-11
	Piping, piping components, and piping elements, and tanks in containment spray and emergency core cooling system	Cracking due to Stress corrosion cracking	Water Chemistry	No	NA	E-12 E-38
PWR	Bolting	Loss of material due to Boric acid corrosion	Boric acid corrosion	No	NA	E-41
	External surfaces	Loss of material due to Boric acid corrosion	Boric acid corrosion	No	NA	E-28
	External surfaces of steel and and aluminum piping, piping	Loss of material due to Boric acid corrosion	Boric acid corrosion	No	NA	EP-2

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL Report

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	SRP Ref	Item Number in GALL
	components, and piping elements					
	Piping, piping components, and piping elements (internal surfaces)	Loss of material due to Boric acid corrosion	Water Chemistry	No	NA	EP-23
	Piping, piping components, and piping elements, and tanks in containment spray and emergency core cooling system	Loss of material due to Boric acid corrosion	Boric acid corrosion	No	NA	E-39
BWR/ PWR	Ducting	None	None	NA - No AEM or AMP	NA - No AEM or AMP	EP-14
	Piping, piping components, and piping elements	None	None	NA - No AEM or AMP	NA - No AEM or AMP	EP-10 EP-11 EP-15 EP-16 EP-17 EP-18 EP-21 EP-22 EP-4 EP-5 EP-6 EP-7 EP-8 EP-9
PWR	External surfaces of steel and and aluminum piping, piping components, and piping elements	None	None	NA - No AEM or AMP	NA - No AEM or AMP	EP-3
	Piping, piping components, and piping	None	None	NA - No AEM or AMP	NA - No AEM or AMP	EP-12 EP-19 EP-20

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL Report

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	SRP Ref	Item Number in GALL
	elements					

Table 3.2-2. FSAR Supplement for Aging Management of Engineered Safety Features

Program	Description of Program	Implementation Schedule*
Bolting integrity (BWR/PWR)	This program includes periodic inspection of closure bolting for Indication of potential problems including loss of reload, cracking, and loss of material. This program consists of guidelines on materials selection, strength and hardness properties, installation procedures, lubricants and sealants, corrosion considerations in the selection and installation of pressure-retaining bolting for nuclear applications, and enhanced inspection techniques. This program relies on the bolting integrity program delineated in NUREG-1339 and industry's recommendations delineated in EPRI NP-5769, with the exceptions noted in NUREG-1339 for safety-related bolting, and EPRI TR-104213 for pressure retaining bolting and structural bolting.	Existing program
Boric acid corrosion (PWR)	The program consists of (1) visual inspection of external surfaces that are potentially exposed to borated water leakage, (2) timely discovery of leak path and removal of the boric acid residues, (3) assessment of the damage, and (4) follow up inspection for adequacy. This program is implemented in response to GL 88-05.	Existing program
Closed-cycle cooling water system (BWR/PWR)	The program relies on preventive measures to minimize corrosion by maintaining inhibitors and by performing non-chemistry monitoring consisting of inspection and nondestructive evaluations based on the guidelines of EPRI-TR-107396 for closed–cycle cooling water systems.	Existing program
Flow-accelerated corrosion (FAC) (BWR/PWR)	The program consists of (1) conduct appropriate analysis and baseline inspection, (2) determine extent of thinning, and replace/repair components, and (3) perform follow-up inspections to confirm or quantify and take longer-term corrective actions. The program relies on implementation of EPRI guidelines of NSAC-202L-R2.	Existing program

Table 3.2-2. FSAR Supplement for Aging Management of Engineered Safety Features

Program	Description of Program	Implementation Schedule*
One-time inspection	To verify the effectiveness of the water chemistry control program by determining if the aging effect is not occurring or the aging effect is progressing so slowly that the intended function will be maintained during the period of extended operation, a one-time inspection of piping, piping components, and piping elements associated with certain BWR emergency core cooling systems [high pressure coolant injection, reactor core isolation cooling, high pressure core spray, low pressure core spray, low pressure coolant injection (residual heat removal)]; and with pipe lines in a BWR plant to the suppression chamber and to the drywell and suppression chamber spray system is performed.	The inspection should be completed before the period of extended operation

Table 3.2-2. FSAR Supplement for Aging Management of Engineered Safety Features (continued)

Program	Description of Program	Implementation Schedule*
Open-cycle cooling water system (BWR/PWR)	The program includes (a) surveillance and control of biofouling, (b) tests to verify heat transfer, (c) routine inspection and maintenance program, (d) system walk down inspection, and (e) review of maintenance, operating, and training practices and procedures. The program provides assurance that the open-cycle cooling water system is in compliance with General Design Criteria and Quality Assurance to ensure that the open-cycle cooling water (or service water) system can be managed for an extended period of operation. This program is in response to NRC GL 89-13.	Existing program
Plant-specific AMP	The description should contain information associated with the basis for determining that aging effects will be managed during the period of extended operation.	Program should be implemented before the period of extended operation
Quality assurance	The 10 CFR Part 50 Appendix B program provides for corrective actions, the confirmation process, and administrative controls for aging management programs for license renewal. The scope of this existing program will be expanded to include nonsafety-related structures and components that are subject to an AMR for license renewal.	Program should be implemented before the period of extended operation

Table 3.2-2. FSAR Supplement for Aging Management of Engineered Safety Features (continued)

Program	Description of Program	Implementation Schedule*
Thermal aging embrittlement of CASS AMP (BWR/PWR)	The program consists of the determination of the susceptibility of CASS piping, piping components, and piping elements in PWR ECCS systems including interfacing pipe lines to the chemical and volume control system and to the spent fuel pool; and in BWR ECCS systems including interfacing pipe lines to the suppression chamber and to the drywell and suppression chamber spray system in regard to thermal aging embrittlement based on the casting method, Mo content, and ferrite percentage. For potentially susceptible piping, aging management is accomplished either through enhanced volumetric examination or component-specific flaw tolerance evaluation.	Existing program
Water chemistry (BWR/PWR)	To mitigate aging effects on component surfaces that are exposed to water as a process fluid, chemistry programs are used to control water impurities (e.g., chloride, fluoride, sulfate) that accelerate corrosion. This program relies on monitoring and control of water chemistry to keep peak levels of various contaminants below the system-specific limits based on EPRI guidelines of TR-103515 for water chemistry in BWRs, and TR-105714 for primary water chemistry in PWRs.	Existing program
BWR Stress Corrosion Cracking	The program to manage intergranular stress corrosion cracking (IGSCC) in boiling water reactor (BWR) coolant pressure boundary piping made of stainless steel (SS) is delineated, in part, in NUREG-0313, Rev. 2, and Nuclear Regulatory Commission (NRC) Generic Letter (GL) 88-01 and its Supplement 1. The program includes (a) preventive measures to mitigate IGSCC and (b) inspections to monitor IGSCC and its effects	Existing Program

* An applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.